

case, viz. that of the electrolysis of fused sodium chloride, Mr. Blount says :

"Thus in practice he who is firmly grounded in these primary principles can deal with each particular case as it arises, not experimenting blindly, but with certain definite and exact generalisations to guide him."

This is very true, but the example taken is one in which the course of reaction is very readily followed out, and although we presume Mr. Blount does not profess to deal exhaustively with this phase of the subject, yet the section would have been much more instructive if Mr. Blount had also included an example where the main reactions are masked by secondary changes.

The next section deals with "Winning and refining of metals by electrolytic means in aqueous solutions." To the winning and refining of copper as being "the largest of all electrolytic industries" is assigned the chief place. The author has failed to treat this part of the subject with sufficient breadth. There are two main methods for obtaining copper electrolytically—the multiple system, in which the anodes and kathodes are suspended opposite to each other, and the series or Hayden system, in which at one end of the vat there is an anode plate, at the other end a kathode plate, the intervening space being occupied with plates of the same quality as the anode plate. These plates function both as anode and kathode, the surface opposite the anode acting as kathode, that opposite the kathode as anode. Mr. Blount has dealt fairly fully with the multiple system, but only very shortly with the Hayden system, which he condemns, hardly, however, giving sufficient evidence for his condemnation. Surely, also, a little more space might profitably have been devoted to the treatment of the anode sludge, the successful working up of which often goes a long way towards making an electrolytic process a paying one.

On p. 125, with reference to the difficulties met with in obtaining nickel in a state of purity, the author gives this useful warning :

"The study of the degree of purification effected by the electrolytic refining of nickel is particularly instructive, and should suffice to dispose of, once for all, the ridiculous belief that a metal prepared by electrolysis is necessarily and *ipso facto* of unusual purity."

The author is hardly correct in saying that no serious attempt appears to have been made to refine tin electrolytically. He is evidently unaware that a patent has been taken out by Mr. Claus for refining impure tin. In Mr. Claus's process, tin cast into plates is made the anode in a bath of sodium sulphide, the kathode being of tinned iron. The impurities, as well as gold and silver, remain in the anode sludge, and tin is deposited in a very high state of purity at the kathode.

Probably the third section, which treats of the electrolysis of fused salts, will be of most interest to the general reader, seeing that under this head the production of aluminium is naturally dealt with. The short section on the electric furnace, carbides and the researches of Moissan, which follows, will repay perusal, if only by pointing out the vast fields of research which the introduction of electricity to chemical processes has opened up.

Section vi., which is assigned to alkali, chlorine and their products, is extremely disappointing. This branch

is, perhaps, one of the most important in the whole range of electro-chemistry, and should therefore have been treated comprehensively. The production of chlorine and caustic soda by electrolysis of common salt receives somewhat exhaustive treatment. But the important, much-worked-at and widely-debated subject of hypochlorites and chlorates, together with the practical and theoretical causes which underlie these processes, are handled most inadequately. The casual reader would carry away the impression that if a cold solution of a chloride is electrolysed without a diaphragm, a solution of a hypochlorite will be produced, but that on electrolysis at high temperatures a chlorate will be obtained. Unfortunately, the electrolysis of a chloride is by no means so simple. There is a very large amount of literature on the subject, and if Mr. Blount had endeavoured to summarise the various methods and the theories advanced, this section would have been very valuable, but he has unfortunately failed to do this.

The part devoted to electrolysis of organic compounds is short, and therefore it would be rash to expect too much from it.

The book as a whole is eminently readable, but it is doubtful whether it will be of much value to the manufacturer or practical chemist. But, in fairness to the author, let us not forget that it is extremely difficult to obtain trustworthy and authentic information of manufacturing processes; the main facts may be published, but it is often the seemingly unimportant details which make or mar a process. The value of the work to the scientific reader would have been greatly enhanced if the author had given references to the original literature from which he obtained his information. To general chemical students the book, although not entirely up to date, may be recommended, in that it deals with the newest of chemical industries in an interesting manner, and will perhaps induce some of the younger chemists to engage in this important branch of study.

F. MOLLWO PERKIN.

SCLATER'S MAMMALS OF SOUTH AFRICA.

The Mammals of South Africa. By W. L. Sclater.

Vol. ii. Pp. xii + 241. Illustrated. (London: Porter, 1901.)

THE first volume of this important work having been already reviewed in these columns, and its main scope and style referred to, our notice of the second and concluding volume may be comparatively brief, especially as it is chiefly devoted to the smaller mammals, such as rodents, bats and insectivora, which command a much smaller sphere of general interest than is the case with their larger terrestrial relatives.

In describing the rodents and bats, the author has been confronted with a task of considerable difficulty on account of having access to the types of many species only during short and busy visits to England. Consequently a considerable portion of this section of the work partakes in some degree of the nature of a compilation; and Mr. Sclater himself would probably be among the first to admit that some amount of revision will have to take place in the future with regard

to certain species and genera. When, however, these great difficulties are taken into account, it must be allowed that the author has fulfilled his task in a highly creditable and satisfactory manner.

And as regards nomenclature, classification and the splitting-up of certain old, unwieldy generic groups like the squirrels into divisions of smaller size, Mr. Sclater is well abreast of modern ideas. One of the most noticeable of these modern changes in classification is the transference of the so-called Cape jumping-hare—the spring-haas of the Boers, from its old association with the jerboas—to a position near the cane-rat and the porcupines. Nor is this all that is noteworthy in Mr. Sclater's remarks on the creature; for we are told that, in spite of the huge bounds it takes, "it is never very rapid in its movements, and can be easily overtaken." This information we have not found given in any of the other works to which we have turned. It is a matter for regret that the portrait of the spring-haas, like many of the other figures in the book, has not been executed in a more satisfactory style.

An old error—to wit, that it burrows—in connection with the cane-rat is also corrected, mainly on the evidence of the late Prof. Peters and Captain Drummond.

Among the most curious and interesting of all the smaller mammals of South Africa are the elephant-shrews, or jumping shrews, and the golden moles, and of each of these Mr. Sclater gives an excellent account, both as regards bodily characteristics and habits, although further observations are stated to be required with regard to the mode of life of the last-mentioned animal.

"The golden mole," writes the author, "is exceedingly common in gardens, where it makes runs in all directions in search of the worms and grubs on which it lives. Although generally supposed to be destructive, it is really a great aid to the gardener, as it destroys quantities of larvæ, especially those of a certain gamma moth. . . . A certain amount of mischief, however, is done by the mole in pursuit of its prey by disturbance of roots and freshly-sewn seeds."

In addition to the Rodentia, Chiroptera and Insectivora, the present volume also includes the South African Cetacea and Edentata. Among the cetaceans special interest attaches to the author's description of a specimen of the lesser sperm-whale recently taken in Table Bay, as the external characters of this rare whale have been hitherto very imperfectly known. Of the specimen in question Mr. Sclater gives a sketch, which shows the characteristic shark-like mouth and small dorsal fin. Certain differences in size which have been thought to indicate specific distinction are, in the author's opinion, probably due to difference of sex in the individuals which have from time to time been examined.

The aard-vark and the pangolin Mr. Sclater, although with some hesitation, still retains in the same order with the typical South American Edentata. And it must be confessed that certain observations which have recently been made with regard to the myology of these creatures tends, so far as it goes, to justify this conservatism. Whether there really is any close relationship between the two groups is a question of the very highest importance in regard to certain views that have been recently expressed in favour of a former connection between Africa

and South America. And it would greatly help matters if a decisive answer could be given on this point.

Mr. Sclater may be congratulated on the completion of a very important and valuable work. R. L.

INFINITESIMAL GEOMETRY.

Einführung in die Theorie der Curven in der Ebene und im Raume. By Dr. Georg Scheffers. Pp. viii + 360. (Leipzig: Veit and Co., 1901.) M. 10.

THIS volume is the first of two which will make a complete work under the title "Anwendung der Differential- und Integral-Rechnung auf Geometrie." The subject-matter of the two volumes may be said to be, roughly, the infinitesimal geometry of curves and surfaces respectively. The first volume is divided into three sections, dealing with plane curves, curves in space, and developable surfaces. The first section does not attempt to be a complete exposition of the subject, and must be regarded as an introduction to what follows, intended to accustom readers who are already well grounded in differential and integral calculus to the style and methods which are employed later. The theory of the curvature of plane curves is based on the definition of contact of an assigned order, which is explained with great exactness. The differential invariants of a curve for the group of movements in the plane are fully investigated, and their properties established in an elementary manner without introducing notions of groups or partial differential equations. Envelopes, evolutes, singular points, and the geometrical significance of differential equations of the first order and degree are discussed shortly. In connection with the trajectories of a family of curves, the problem is completely solved of finding all curves for which the product of the normal and radius of curvature is constant. The remainder of the first section is devoted to an explanation of curvilinear coordinates.

The second section contains a thorough and systematic account of the curvature, torsion, and allied theory of curves in space. The dual interpretation of an orthogonal substitution of coordinate as a change of frame of reference and as a movement in space is first carefully explained, and the theory of the intrinsic properties of curves is built upon it. Particularly interesting are the discussions of the differential invariants and of the integration of the intrinsic equations of a curve, in the course of which an elementary account of Riccati's equation is given. Conditions for contact of an assigned order are carefully laid down, and from them the relations between a curve and its osculating circle and helices are deduced; in particular we have the interesting result that the axes of all osculating helices at any point generate a cylindroid.

In the third section the main properties of the surface generated by the tangents to a curve are established. The general ruled surface is introduced in order to provide a rigorous investigation of what is meant by saying that consecutive generators intersect. The remainder of the section is occupied with various loci connected with a given curve, such as evolutes, involutes, parallel curves, polar surface, rectifying surface, etc. The text ends with a short account of minimal lines and minimal curves.